

FELLOWS-IN-TRAINING & EARLY CAREER PAGE

Handheld Ultrasound and Diagnosis of Cardiovascular Disease at the Bedside



Brandon Wiley, MD, Bibhu Mohanty, MD

In 1903, Dr. William Osler advocated for reform of medical education to emphasize bedside teaching, recommending “no teaching without a patient for a text and the best teaching is that taught by the patient himself” (1). More than a century later, new voices in the profession echo that sentiment, suggesting that diagnosis has again strayed from the bedside. Some propose that technology has usurped the clinical examination at the expense of patient care and the cognitive development of practitioners. Proponents of bedside medicine lament that ward rounds have been reduced to examining a patient’s electronic medical record and clicking computerized order sets based on results of myriad prior diagnostic tests.

Inspection of jugular venous pulsations, palpation of the precordium, and auscultation of heart tones are multisensory experiences that require the physician to integrate observation, touch, and hearing in the context of the patient’s clinical history and symptoms. The medical history provides a framework for developing a logical differential diagnosis. For example, in evaluation of chest pain syndromes, a thorough history characterizing the quality, severity, location, duration, and tempo of symptoms can guide diagnosis, risk stratification, and management. Incorporation of Bayesian theory can enhance diagnostic accuracy based on rational statistical inference, thereby increasing the predictive power of ancillary testing. By reducing false-positive results, costly testing can be avoided.

“Bedside” treatment extends to all physical interactions with our patients, which are integral for an appropriate diagnosis and care plan. Correctly

elicited and interpreted findings from a physical examination reveal the underlying pathology and direct the selection of diagnostics and therapy. “Laying hands” on a patient with heart failure to assess the warmth of extremities is a valid gauge of cardiac index and the need for inotropic augmentation. Evaluation of jugular venous pressure and hepatojugular reflux provides a noninvasive evaluation of ventricular filling pressures. The assessment of the intensity, radiation, and timing of murmurs distinguishes the type and severity of valvular lesions. Combining auscultation with a thorough history and physical examination is crucial in the evaluation of patients with valvular heart disease because astute clinical assessment for the presence of symptoms can make the difference between a strategy of “watchful waiting” and the need for surgical intervention.

Perhaps most importantly, patients view the examination as an important part of the medical process. Performing a physical examination positively influences patient perceptions, impacts their satisfaction with providers, and improves understanding of disease. A patient survey found that 95% viewed bedside rounds positively, and 66% understood their illness better as a result (2). Thus, the bedside examination has tangible healing power derived from strengthening the doctor-patient relationship by placing *the patient*—not diagnostic data—at the center of the evaluation in a collaborative manner with the physician. In Dr. Osler’s words, “The good physician treats the disease; the great physician treats the patient who has the disease” (3).

Although there is evidence correlating physical examination findings with pathological diagnoses, the declining practice of the traditional examination has eroded its reproducibility and accuracy. Contemporary studies of auscultation proficiency, even with the use of electronic stethoscopes, have been

disappointing. One potential solution for the deficiencies of the physical examination is incorporation of point-of-care ultrasound in the bedside evaluation. In well-trained hands, handheld ultrasound (HHU) is recognized to be accurate and reproducible for assessment of cardiac structure and function by the American Society of Echocardiography (4).

Using HHU in conjunction with the physical examination has been demonstrated to improve detection of cardiac abnormalities by at least 31.5% (5). The additive benefit of improved sensitivity and accuracy afforded by incorporation of HHU into the physical examination has been demonstrated across the spectrum of doctors, from medical trainees to experienced cardiologists (6,7). Specifically, HHU performs well in the evaluation of left ventricular systolic dysfunction, a cardiac abnormality that is difficult to detect by the traditional physical examination when the patient is asymptomatic. In the outpatient cardiology clinic, HHU improved the number of diagnoses made from 23.3% to 74.6%, leading to rapid clinical decisions and fewer tests (8). Outpatient protocols have also been developed that leverage the ability of HHU to detect subclinical cardiovascular disease and thus provide prompt and cost-effective cardiovascular risk screening (9).

HHU's portability and wireless transmission capability provides the potential to improve global access to cardiac assessment. Large studies in rural India have combined HHU with remote image interpretation to provide cardiac evaluation for thousands of patients (10). Smartphone software advances could further the global impact by allowing real-time interpretative guidance.

Although HHU presents a tremendous resource for the evaluation and detection of cardiovascular disease, there are some challenges facing the widespread application of the devices at present. Without

adequate training, the sensitivity of HHU is tempered by suboptimal specificity. Thus, educational protocols should be developed for noncardiologists to ensure safe and accurate implementation of the technology.

The traditional bedside evaluation allows the physician to develop a logical hypothesis and rationally direct care through a collaborative interaction that strengthens the therapeutic patient-physician relationship. Portable HHU can be incorporated into this bedside paradigm. When utilized by well-trained operators as an extension of the physical examination, HHU has the potential to improve the efficacy of bedside evaluation, provide valuable information to guide patient care, and increase access to cardiovascular assessment worldwide. HHU should not be viewed as another technological barrier that threatens to disrupt the sacred patient-physician interaction. Instead, this technology enables the visualization of cardiac anatomy and physiology while at the bedside, in direct physical contact with the patient. Like the stethoscope, HHU is a tool for the physician's legendary "black bag" that simply provides diagnostic data. The true value of these data is dependent on the thoughtful and accurate interpretation by the practitioner in the context of the patient's clinical condition. In this sense, Dr. Osler's dictum that the examination of a patient must include contemplation still holds merit. It has been said that the most crucial part of the auscultatory exam is "what exists between the ears of the listener," and the same can be said of a comprehensive evaluation with the assistance of HHU.

ADDRESS CORRESPONDENCE TO: Dr. Brandon Wiley, Zena and Michael A. Wiener Cardiovascular Institute, Mount Sinai Medical Center, One Gustave L. Levy Place, New York, New York 10029. E-mail: Brandon.Wiley@mountsinai.org.

REFERENCES

1. Osler W. On the need of a radical reform in our methods of teaching senior students. *Med News* 1903;82:49-53.
2. Linfors EW, Neelon FA. Sounding boards. The case of bedside rounds. *N Engl J Med* 1980;303:1230-3.
3. Porter R. *The Cambridge History of Medicine*. New York, NY: Cambridge University Press, 2006.
4. Spencer KT, Kimura BJ, Korcarz CE, et al. Focused cardiac ultrasound: recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr* 2013;26:567-81.
5. Galderisi M, Santoro A, Versiero M, et al. Improved cardiovascular diagnostic accuracy by pocket size imaging device in non-cardiologic outpatients: the NaUSiCa (Naples Ultrasound Stethoscope in Cardiology) study. *J Cardiovasc Ultras* 2010;8:51.
6. Kimura BJ, DeMaria AN. Technology insight: hand-carried ultrasound cardiac assessment—evolution, not revolution. *Nat Clin Pract Cardiovasc Med* 2005;2:217-23, quiz 224.
7. Panoulas VF, Daigeler AL, Malaweera AS, et al. Pocket-size hand-held cardiac ultrasound as an adjunct to clinical examination in the hands of medical students and junior doctors. *Eur Heart J Cardiovasc Imaging* 2013;14:323-30.
8. Cardim N, Fernandez Golfín C, Ferreira D, et al. Usefulness of a new miniaturized echocardiographic system in outpatient cardiology consultations as an extension of physical examination. *J Am Soc Echocardiogr* 2011;24:117-24.
9. Kimura BJ, Shaw DJ, Agan DL, et al. Value of a cardiovascular limited ultrasound examination using a hand-carried ultrasound device on clinical management in an outpatient medical clinic. *Am J Cardiol* 2007;100:321-5.
10. Singh S, Bansal M, Maheshwari P, et al. American Society of Echocardiography: Remote Echocardiography with Web-Based Assessments for Referrals at a Distance (ASE-REWARD) study. *J Am Soc Echocardiogr* 2013;26:221-33.